

Ollscoil na hÉireann, Gaillimh
National University of Ireland, Galway

GX 921

Semester II Examinations, 2002/2003

Exam Code(s)	1PT1
Exam(s)	1 st Physics and Astronomy
Module Code(s)	AT101
Module(s)	Astronomy 1
Paper No.	1
Repeat Paper	Special Paper
External Examiner(s)	Professor E. Kennedy
Internal Examiner(s)	Professor S.G. Jennings
	Dr. C. Brown
	Dr. M.J. Lang

Instructions: Answer any THREE questions.
All questions carry equal marks

Duration	2 hrs
No. of Answer Books	1

Requirements:

Handout	
MCQ	
Statistical Tables	
Graph Paper	
Log Graph Paper	
Other Material	

No. of Pages	4
Department(s)	Experimental Physics, Applied Geophysics

Q.1 Answer True (T) or false (F) for each part. Each correct answer is worth plus 1/2 marks. Each unanswered part is worth zero marks. Each incorrect answer is worth minus 1/2 marks. Maximum marks 10, minimum marks zero.

(a) Venus has the following characteristics

- (i) oxygen atmosphere
- (ii) volcanoes
- (iii) greenhouse effect
- (iv) surface temperature of about 1 million °C

(b) The Earth

- (i) has an average density of $\sim 2670 \text{ kg m}^{-3}$
- (ii) has a temperature that decreases with depth
- (iii) has a mantle composed almost entirely of iron
- (iv) is slightly flattened at the poles

(c) The Solar System

- (i) contains comets with circular orbits around the Sun
- (ii) is located within one of the arms of the Milky Way galaxy
- (iii) has 4 terrestrial planets and 4 Jovian planets
- (iv) has a sun that converts helium to hydrogen by nuclear fission

(d) Seismic waves

- (i) travel faster in air than in rock
- (ii) are detected by instruments called seismograms
- (iii) do not travel through fluids
- (iv) have magnitudes measured on the Richter scale

(e) The magnetic field of the Earth

- (i) points 68° west of north in Ireland
- (ii) varies with time
- (iii) dips upwards in the southern hemisphere
- (iv) has an inclination of 0° at the magnetic equator

Q.2 Answer parts (a) and (b):

- (a) Draw a rough graph of the spectra of radiation emitted by blackbodies at temperatures T_1 and T_2 , where $T_1 > T_2$. State the Stefan-Boltzmann law and Wien's displacement law for blackbodies.

The photosphere of a Star has a temperature of 7250K and its blackbody spectrum peaks at 400nm. Calculate the temperature of stellar spots in the photosphere, whose blackbody spectra peak at 570nm. Calculate the ratio of the intensities of the photosphere and stellar spots. [5 marks]

- (b) Briefly outline three objectives of telescope design. Outline some of the aberrations associated with refracting and reflecting telescopes. Calculate the diffraction limited resolution of a telescope with a 12cm aperture at a wavelength of 600nm. Quote your answer in seconds of arc. [5 marks]

Q.3 Answer parts (a), (b) and (c):

- (a) Explain what are meant by the sidereal period and synodic period of a planet. Given that Jupiter has a sidereal period of 11.86 years, calculate its synodic period. [3 marks]
- (b) Outline how observations of the Transits of Venus can be used to measure the Astronomical Unit (AU). [4 marks]
- (c) With the aid of diagrams, discuss how the phases of Venus and the phases of Mars differ. [3 marks]

Q.4 Answer parts (a), (b) and (c):

- (a) Why does nuclear fusion liberate energy? Describe the fusion cycle by which energy is produced in the Sun. [3 marks]
- (b) Explain how parallax is used to measure the distance to nearby stars and explain what is meant by a parsec.

Convert one parsec into (i) astronomical units, (ii) meters, (iii) light years. [3 marks]
- (c) Derive an expression that relates the absolute magnitude, the apparent magnitude, and the distance to a star. What is the absolute magnitude of the star Regulus if its parallax is 0.0421" and its apparent magnitude is 1.36 ? [4 marks]

Q.5 Answer parts (a) and (b):

- (a) Explain what are meant by a visual binary, a spectroscopic binary and an eclipsing binary. Briefly mention how the mass of a star may be measured. [4 marks]
- (b) What is the relationship between stellar mass and luminosity? What is the physical basis of this relationship?

What is the relationship between stellar mass and main sequence lifetime? Discuss the usefulness of observations of open clusters as a test of this relationship. If the Sun has an expected main sequence lifetime of 9×10^9 years, estimate the lifetime of a 5 solar mass star [6 marks]